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"المحددات العملياتيه لكفاءة أقسام الإدخال للمستشفيات في الأردن"

"Title: The Operational Determinants of Hospitals' Inpatients Departments Efficiency in Jordan"

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إشراف

الدكتور يزن خالد مقدادي

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The Operational Determinants of Hospitals' Inpatients Departments Efficiency in Jordan

إعداد

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وقد وافق عليها

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الإهداء

بسم الله الرحمن الرحيم

(وَقُلِ اعْمَلُوا فَسَيَرَى اللَّهُ عَمَلَكُمْ وَرَسُولُهُ وَالْمُؤْمِنُونَ)

صدق الله العظيم

ألى من بَلغ الرسالة و أدى الامانة إلى نبي الرحمة و شفيع الأمــة

إلى سيد المرسلين صلى الله عليه وسلم

إلى سماء حياتي التي تمطر رعايه وحب وعطاء (والدي العزيز)

إلى الريحانة التي تسقينا من رحيقها عطف وحب وحنان (أمي الغالية)

إلى باقه الدحنون التي تلون حياتي بالسعاده(إخوتي واخواتي)

إلى النجمات التي تناثرت حولى إلى من سرنا سويا ونحن نشق الطريق معا نحو النجاح والإبداع (صديقاتي وزميلاتي)

إلى الينابيع النقية التي طالما شربنا منها علما ومعرفة (اساتذتي الكرام)

إلى كل انسان عزيز على قلبي إلى (شريك حياتي)

إلى كل هؤلاء وهؤلاء أهدي هذا العمل المتواضع

الباحثة

الشكر والتقدير

الحمد الله الذي هدانا لهذا وما كنا لنهتدي لولا أن هدانا الله، أحمد ربي وأشكر فضله ونعمه وأصلي وأسلم على سيدنا محمد (صلى الله عليه وسلم)و معلم البشرية، والهادي إلى النور.

إن لساني ليعجز أن يجد الكلمات التي يعبر بها عن شكري وامتناني و تقديري لمعلمي واستاذي الدكتور يزن مقدادي الذي اشرف على هذه الرسالة وأعطاني الكثير من علمه، ووقته، وجهده، وكان كريما في نصحه وإرشاده وعطائه، لتخرج هذه الرسالة في ابهى الصور، والذي اليه الفضل بعد الله بخروج هذه الرسالة إلى النور، أطال الله في عمره، وجعله الله دائماً وأبداً عوناً لطلابه على طريق العلم.

وأتقدم بأسمى آيات الشكر والعرفان والتقدير للأستاذ الدكتور جمال ابو دوله و الأستاذه الدكتوره منى مولأ لتفضلهما بمناقشة رسالتي هذه، وإنه ليسرني أن استزيد من علمهما وملاحظاتهما القيمة.

كما أتوجه بالشكر والتقدير لأساتذتي الاعزاء واخص بالذكر الدكتور عبد الفتاح كراسنه، الدكتور عبد الباسط عثامنه والاستاذ صالح العمر.

الباحثة

Abstract

The aim of this research is to evaluate and measure the efficiency of public hospitals' inpatients departments in Jordan in 2012, and to determine the operational factors impact on the efficiency of hospitals' inpatients departments. Secondary data was collected from Annual Statistical Reports of Ministry of Health website. This research surveyed 15 out of 31 hospitals, and it investigated 9 out of 12 departments.

This research used non-parametric techniques to analyze data; DEA technique to measure efficiency, Mann-Whitney U to compare the differences of efficiency among hospitals and among departments, and Kruskal Wallis H-Test to identify the significant differences between urban and suburban hospitals, and Spearman correlation coefficient to identify the impact of ALOS, capacity, and occupancy rate on efficiency.

This research classified the hospital's inpatients departments into five categories: extremely high efficient, highly efficient, moderately efficient, low efficient and extremely low efficient. The research did not find any significant differences of efficiency among all departments except among some: such as ear nose and throat department with some departments on one hand, ICU department with gynecology on the other hand, in addition to this, some significant differences of efficiency have been identified among some hospitals. It was found that the location of hospital, capacity, and ALOS are not determinants of efficiency for all hospitals' inpatients departments; occupancy rate is a determinant of efficiency for some hospitals.

Keywords: Efficiency, Data Envelopment Analysis (DEA), Average Length of Stay (ALOS), Inpatients, Occupancy, Capacity, Determinants.

List of Abbreviations

DEA	Data Envelopments Analysis
DMU	Decision Making Unit
ALOS	Average Length of Stay
TE	Technical Efficiency
E	Efficiency
MOH	Ministry of health
DOS	Department of Statistics
JNHA	Jordan National Health Accounts
SFA	Stochastic Frontier Analysis

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Chapter One

Research Introduction

1.1 Introduction

This chapter contains eight sections, starting with the research importance. The main aim of this chapter is to briefly introduce the research project to provide the readers and the field's superintendents with general overview of the research project, as well as, it talks about Jordan, healthcare sector of Jordan. Accordingly, the research importance, gaps and contribution, research aim and objectives, research questions, and overview of healthcare sector in Jordan were discussed.

1.2 Research Importance

Over the last few years, especially after the financial crises of 2007 that increased deficit of governments and public debt, hospitals in the world either in developing or developed countries have been directed toward more efficiency in utilizing the resources available. This issue is more urgent for hospitals in developing countries as a result of high fertility rate, population growth, and limited resources in comparison with developed, As the number of physicians per 10,000 people is 2.5 in the African region, 10.8 in the Middle East Region however, the number of physicians is 20.4 in the American region and 33.3 in the European region (World Health Organization, 2013).

Jordan is considered one of the leading countries in Healthcare service among its regional, thus Jordan became the best choice for the neighboring countries' patients (Migdadi, 2013). According to Jordinvest report sector of 2012, physicians density in Jordan is similar to that in USA and higher than the average level in the region which, equals "25.5 physicians per 10,000 capita". Identifying inefficient hospitals can help top administrators of ministry of health to make decisions about health resources distribution to

hospitals that will need to benefit from additional resources and this research will help them to achieve it, the quantity of excess resources used or/and shortage of outputs produced by inefficient hospitals can represent the magnitude of inefficiency (Al Shammari, 1999).

The importance of using DEA technique in this research resulting from its various advantages such as: the efficiency measure is related to best practice not average practice, it does not require the distributional assumptions about error terms, and it does not use a predetermined functional form for technology because of it is a non-parametric approach. Moreover, the DEA method does not require cost minimization (Gannon, 2004). It is used when multiple inputs and outputs are observed and when it is not possible to convert them into one aggregate input or output factor (Martín, 2003).

There are operational determinants related to the operations actions including ALOS, occupancy rate, capacity as number of admission and location, where the average length of stay and number of admission have an adverse effects on efficiency. Over the last ten years, in all countries, the emphasis was on reducing the length of stay and the number of admissions; and in the next decade, the hospitals will continue reducing unsuitable length of stay and admission to be more efficient (European Hospital and Health Federation, 2011). In addition, bed occupancy rate gives an indicator especially with ALOS on effective demand and efficiency on health services (Raoof, 2007). Accordingly, operations managers of hospitals should take into consideration those operational determinants which, influence hospitals' efficiency.

1.3 Research Gaps and Contribution

Every hospital has many departments, each department is attributed as a strategic healthcare unit, so it requires particular healthcare professionals with some exchange among departments, and it serves different kinds of patients, each department requires separate assessment as a unit, while the previous studies have focused on reporting mainly the relative efficiency for the hospital as a whole, (e.g. Ajlouni, 2013; Al Shammari, 1999; Zere, 2000; Maruotti, 2007; Uslu and Linh, 2008; Jacobs, 2000; Helmig and Lapsley, 2001). The limited number of previous studies investigated the operational determinants (e.g. Migdadi, 2013; Toodi et al., 1998; Jones, 2013; Raoof, 2007). Previous studies did not investigate and determine the impact of ALOS, occupancy rate, capacity and location simultaneously on hospitals' efficiency. In addition, they did not investigate the differences among hospitals' efficiency and the differences among departments' efficiency.

Accordingly, this research will evaluate, measure the efficiency of public hospitals' inpatients departments, and determine the impact of hospitals' operational factors on their efficiency. Each department is considered as strategic unit that requires deep analysis (Migdadi, 2013).

1.4 Research Aim and Objectives

The aim of this research is to evaluate and measure the efficiency of public hospitals' inpatients departments in Jordan as a case in developing countries, and to determine the operational factors impact on the hospitals' efficiency, the realization of the following objectives leads to realize this aim:

1. Identifying the efficiency levels of fifteen public hospitals' inpatient departments.

2. Examining the differences among hospitals' efficiency and the differences among departments' efficiency.

3. Measuring the operational factors (location, capacity, ALOS and occupancy rate of public hospitals' inpatients departments.

4. Examining and comparing the operational factors impact on the efficiency of public hospitals' inpatients departments.

1.5 Research Questions

The research is hoping to answer the following questions:

1) What are the efficiency levels of public hospitals' inpatients departments?

2) Are there significant differences of efficiency among hospitals and among departments?

3) What is the impact of operational factors on efficiency of public hospitals' inpatients departments?

1.6 Overview of Health Sector in Jordan

1.6.1 Overview of Jordan

Officially known as the Hashemite Kingdom of Jordan. It is one of the developing countries, which is located at South West of Asia in the Middle East. It represents the three powers: The Legislative, the Judicial, and the Executive authority. Its total area equals 89,342 km^2. (Ministry of Tourism and Antiquates, 2010).

1.6.2 Classification of the Healthcare Sector

By virtue of health law number 54 for 2002, Ministry of Health manages the healthcare sector, Jordan health services can be classified into public and private sector (1)The public sector, in which public hospitals represent major part of health sector and it includes (a)Ministry of Health (MOH), (b)Royal Medical Services (RMS), (c)Medical services in public universities that consist of Jordan University Hospital (JUH) and King Abdullah University Hospital (KAUH) (d)Health services in the ministries and government institutions that include Greater Amman Municipality and the municipalities in the provinces of the Kingdom, Department of School Health in the Ministry of Education and Department of Health and Safety and Ministry of Labor (2)The private sector can be classified into (a)Private Hospitals, (b)Private doctors' offices and (c)Diagnostic and Therapeutic Centers, and Medical support services (3)International and charitable sector ,which includes (a)The United Nations Relief and Works Agency (UNRWA) and (b)Clinics and health services of the charitable organizations (4)Councils and organizations that include (a)Higher Health Council, (b)Jordanian Medical Council, (c)Jordanian Nursing Council and (d) Food and Drug Administration.

1.6.3 Hospitals Statistics and Services

In Jordan, public sector includes 45 hospitals in all of its health bodies: 31 Ministry of Health, 12 Royal Medical Services (military) and 2 teaching (JUH and KAUH). In addition, private sector includes 61 private hospitals, the total capacity of hospitals is 12106 beds, the number of beds per 10,000 is 18, occupancy rate on average is 62.8 %, and average length of stay 3.1 days, further hospital numbers (beds) increased from 103 (11200) in 2008 to 106 (12106) in 2012. However, the budget of the Ministry of Health has decreased from 7.4% of the total government budget to 6.3%. (Ministry of Health, 2012). It is worth mentioning that total expenditure on health per capita (Intl $) is 505 and total expenditure on health of GDP is 8.4 % (WHO, 2011).

The following Figure (1-1) shows that the number of population is increasing over time.

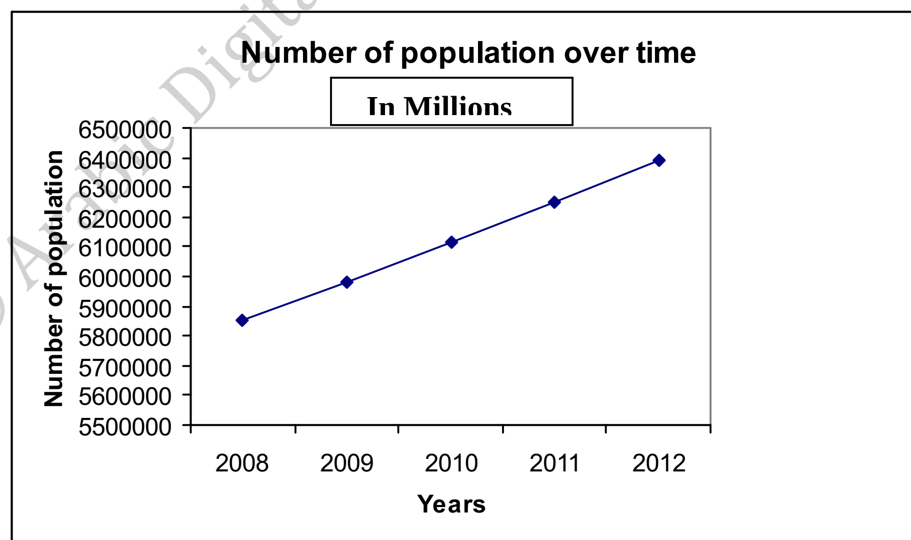


Figure (1-1): Number of population over time

Developed by the researcher

The following Figure (1-2) shows that admissions were wobbling and almost the number of admission has not increased despite the substantial increase of the population number, which indicates that health sector is improving over time in Jordan.

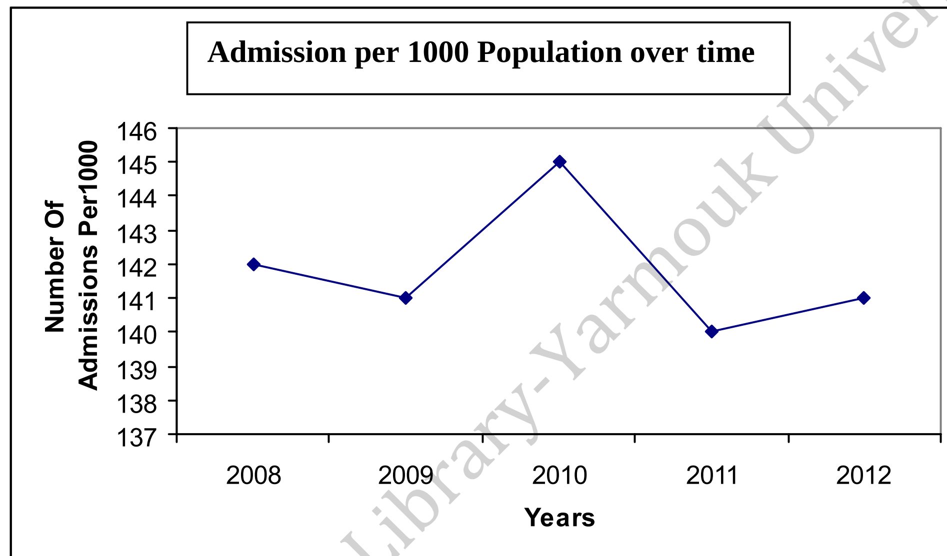


Figure (1-2): Admissions per 1000 population over time

Developed by the researcher

Ministry of Health operates an extensive primary care network that represents the main institutional source of primary and hospital care in Jordan (Ajlouni, 2013). According to the MOH (2012), it consists of 211 peripheral health clinics, 372 primary health centers, 444 maternal and child health clinics, 92 comprehensive health centers, 384 dental clinics, and 12 chest disease centers.

The following Table (1-1) presents some data about hospitals and the main ratios during the period (2008-2012). It can be seen that; hospital beds has increased from 11200 beds in 2008 to 12160 beds in 2012; ALOS has decreased from 3.2 days in 2008 to 3.1 days in 2012; admission per 1000 population has decreased from 142 in 2008 to 141 in 2012; and the average occupancy rate has decreased from 65.1% in 2008 to 62.8% in 2012. In addition, MOH budget has decreased from 7.4 in 2008 to 6.3 in 2012.

Table (1-1): Health care sector statistics in Jordan during the period (2008-2012)

Country Demographic and Health Data	2008	2009	2010	2011	2012
Hospitals Number	103	104	106	106	106
Hospital Beds	11200	11355	11779	11991	12106
_ Ministry of Health	4333	4358	4373	4572	4612
_ Royal Medical Services	2129	2131	2412	2428	2383
_ Jordan University Hospital	522	519	602	547	544
_ King Abdullah University Hospital	504	494	504	526	526
_ Private Sector	3712	3853	3888	3918	4041
Hospital Utilization					
1 - Hospital Bed /10000 pop	18	18	18	18	18*
2 - Admissions Per 1000 Pop	142	141	145	140	141
3 - Average Occupancy Rate (%)	65.1	61.7	62.3	63.6	62.8
4 - Average Length of Stay (days)	3.2	2.9	3.0	3.1	3.1
5 - Average Death Rate (%)	1.4	1.6	1.6	1.6	1.6
MOH Health Centers					
1 - Comprehensive Health Centers	68	70	84	86	92
2 - Primary Health Centers	375	378	368	371	372
3 - Peripheral Health Centers	240	236	227	220	211
4 – MCH ,Centers	419	431	432	435	444
5 - Chest Disease Centers	12	12	12	12	12
6 - Dental Clinic	313	349	369	377	384
MOH Budget as (%) of Total Governmental Budget	7.4	8.0	7.9	6.3	6.3
Per Capita of GDP (JD)	2425.6	2720.0	3194.5	3276.7	3439.0

Sources: DOS (Department of Statistics), MOH (Ministry of Health), JNHA (Jordan National Health Accounts).

1.7 Research Structure

This paper includes seven chapters organized as follows:

Chapter 1 (Introduction)

The main purpose of this chapter is to briefly introduce the research project to provide the readers with general overview of the research project, in addition, it talks about Jordan, and the healthcare sector of Jordan. Accordingly, the research importance, gaps and contribution, research aim and objectives, research questions, and overview of healthcare sector in Jordan are discussed.

Chapter 2 (Literature Review)

This chapter includes a summary of the previous studies, which are relevant to the topics covered in this research, such as efficiency measurement, Data Envelopment Analysis (DEA), operational determinants, and summary of previous studies.

Chapter 3 (Efficiency Measures and Analysis Techniques)

The aim of this chapter is to explain the most important points of efficiency. Definition of efficiency, measures of efficiency and techniques of analysis are explained in this chapter.

Chapter 4 (Conceptual Framework)

The aim of this chapter is to discuss theoretical background of operational determinants, to estimate research model, and to formulate alternative hypotheses. It includes five sections: definition of operational determinants, categories of operational determinants, relationships between efficiency and operational determinants, conceptual model, and hypotheses.

Chapter 5 (Methodology)

The purpose of this chapter is to identify the research methodologies used to achieve the research objectives. Moreover, it is used as a road map of research project that included six sections.

Chapter 6 (Data analysis and findings)

The findings of the data analysis are shown in this chapter which can be divided into two main parts, data analysis of productive efficiency of hospitals' inpatients departments and data analysis that shows the relationships between the efficiency of hospitals' inpatients departments and location of hospital, ALOS, capacity and occupancy rate by using different analysis techniques.

Chapter 7 (Discussion and Conclusions)

The purpose of this chapter is to explain the results of this research and how they are consistent with previous studies and to report the conclusions and recommendations. Furthermore, it explains the interpretations and opinion of researcher. This chapter is divided into four sections: efficiency, operational determinants, contribution and results, and applications and future research.

1-8Conclusion

The purpose of this chapter is to introduce the research project to provide the readers and the field's superintendents with general overview of the research project. Research importance, aim and objectives, gaps and contribution, research questions, overview of healthcare sector in Jordan, and research structure were discussed in this chapter.

Chapter Two

Literature Review

2.1 Introduction

This chapter includes a summary of the previous studies. This chapter includes three sections, the first section discusses the literature review of efficiency, the second section discusses the literature review of operational determinants and the last summarizes previous studies.

2.2 Literature of Efficiency

Helmig and Lapsley (2001) research identified the efficiency level of the German hospital sector by using DEA with the assumption of constant returns to scale, it compared the relative efficiency between private, public, and welfare hospitals. The volume of cost savings is also estimated by this research.

The justifications for this research have been to avert an explicit rationing of healthcare services due to rapidly increasing expenditure that has been faced by German health care system. The data used in this research was from statistical yearbooks of German Federal Statistics Office during the period (1992 – 1996). This data included 3 inputs: number of beds, employees and amount of operational expenses, and 2 outputs: inpatient discharges and amount of expenses for educational facilities and teaching.

They found that the private hospitals were less efficient than welfare and public hospitals. This means that the ownership affects the efficiency measurement whereas welfare and public hospital sectors seem to use relatively fewer resources and all of them have different best practice frontiers.

Gannon (2004) research used DEA and SFA to measure technical efficiency of acute public hospitals in Ireland during the period (1992 – 2000). This research divides the sample of hospitals for analysis into 3 categories: 62 hospitals for the period (1992 – 1994), 61 for the period (1998 – 2000) and 58 hospitals from 1998 to 2000. As well as the hospitals classified according to country, and specialization to general and regional hospitals.

This research has been used two inputs: total number of beds and employees, and two outputs: total number of inpatients and outpatients. There are some limitations of this research. These limitations are: The measurement of the output is not corrected for different procedures among hospitals, and the methods applied are basic and were introduced in the early eighties.

This research found that county and general hospitals are less efficient than regional hospitals. It shows that the lower efficiency scores using SFA method resulting from high levels of random error in the data. The results of this research contribute to the expanding literature of comparisons between DEA and SFA applications.

Rebba and Rizzi (2006) research measured the technical efficiency of 85 (private and public) hospitals in Veneto, Northern Italy, by developing four DEA models. How the choice of the specific constraints of output and input weights is selected and took into account the exogenous variables that considered out of control of hospital management that affect the measurement of hospital technical efficiency using (DEA) was shown by this research.

The data used in this research was from the hospital discharge records of the Ministry of Health and database for Veneto region 1997. As well as, 95 public and private hospitals that actually existed in Veneto but 85 of those are included in this research due to lack of some information. The sample consists of 59 Local Health Authority's public hospitals, 2 teaching hospitals, and 24 private hospitals 7 of which are non-profit. This data included 5 inputs: the number of physicians, the number of nurses, the number of other employees, the number of hospital beds, and the total number of acute care admissions, and 3 outputs; inpatients days, the number of treatments provided by emergency services and the number of acute care discharges with Diagnosis Research Group weights.

This research found that nonprofit and profit hospitals showed higher levels of inefficiency than public ones but nonprofit private hospitals displayed the highest total inefficiency.

Maruotti (2007) identified favorable evaluation methods for comparison between different kinds of Italian healthcare hospitals, which addresses the issue of inefficiency in health services. Increasing hospital efficiency is a means for reducing its spending through reducing the cost of hospital care by reducing the beds number. The data used in this research for 2001 and 2002 years refer to 102 public hospitals and for 2003 refer to 97 public hospitals .

This research examined two main approaches: simple ratio analysis and stochastic frontier analysis (SFA), parametric approach, as they apply to healthcare services. Where Frontier methods measure efficiency in terms of distance between best practice frontier

and actual performance. It found that reduced spending could result in improved efficiency only when adjustment is made within the management structure and entire production.

Yawe (2010) measured the technical efficiency of 25 Uganda's hospitals: 7 from the Eastern, 8 from Western and 10 from the Central regions over the period (1999-2003) , it used Standard Data Envelope Analysis models and classified them into four groups: inefficient, efficient, super efficient , and strongly super efficient.

Secondary data was used in this research from the databases of Health Management Information System. This data included four inputs: doctors, other staff, nurses, and beds, and four outputs: deliveries, admissions, outpatient department attendances and operations. This research found differences in degrees of technical and scale inefficiency in hospitals of Uganda.

Ajlouni (2013) research measured the relative efficiency of public hospitals performance in Jordan, during the period (2006-2008) by using DEA as a multi-criteria nonparametric technique for analysis and Pabon-Lasso Diagram for plotting the results to interpret efficiency.

Secondary data used in this research was published by the Ministry of Health as Annual Statistical Reports. This data included 3 inputs: annual number of bed days, number of physicians per year, and number of health personnel per year, and 3 outputs: patient days, minor operations and major operations. This research found that the average efficiency of those fifteen hospitals ranges from (73%) to (100%) and the average of the relative efficiency of those hospitals over prescribed period is 94%, 8 out of 15 inefficient hospitals in 2006 decreased to 6 in 2007, but increased to 7 in 2008.

2.3 Literature of Operational Determinants

Toodi, Featherston and Young (1998) research examined the technical, allocative, scale economic, and overall efficiency of hospitals in the Great Plains by using Fare's non-parametric approach during the period (October, 1991 and September 30, 1992). Where efficiency is calculated for each of hospitals then, compared between the relative efficiency of urban (255 hospitals) and rural (548 hospitals) in the data set.

The data used in this research was from the Hospitals Cost Report Information System. Inputs in this research consisted of: number of staff, hours of physicians, direct cost, and capital costs. Outputs included: outpatient revenue, nonpatient revenue and inpatient revenue. hospital characteristics that correlated with efficiency included: type of ownership, employees per inpatient, inpatient days, medicaid discharges, number of beds, sole community hospital, etc.

This research found that rural hospitals are relatively less efficient than urban hospitals. and it found that employees per inpatient day and hospitals' operational performance is statistically significant for allocative, scale, and overal efficiencies, nonprofit and public hospitals, for all efficiency measures, are more efficient than private hospitals; medium sized hospitals are less allocativly and technically efficient than small and large hospitals.

Raoof (2007) research identified the main lines for planning, considerations of governmental hospitals within healthcare sector in Iraq which reflects positively the process of planning, feasibility studies, design, execution and utilization of these hospitals, thus it can help to raise the efficiency of these hospitals' service.

The justifications for this research come from the increasing demand for healthcare services in Iraq over time due to population growth. Furthermore this research focused more on the importance of new hospitals rather than the reconstruction and rehabilitation

Factors influencing the efficiency of health sector in Iraq are classified by this paper into medical factors and non medical factors. medical factors include number of obtainable beds, number of staff ratio to population, ALOS, occupancy rate and number of patients to population. Non medical factors include social, economic, cultural and natural factors that can have an influence on type, degree and nature of the use of health services by people.

McDermott and Stock (2007) research used the operations strategy framework to estimate the relationship between average length of stay (ALOS) as hospital performance indicator and a set of operational elements (variables) as capital, Salary, capacity (measured by the number of beds), location (urban or non-urban areas), teaching status of the hospital (teaching or non-teaching).

The data used in this research was submitted by the New York state hospitals' population to the statewide planning and research cooperative system database of 2002 as a snapshot research. Working sample included 188 hospitals, and it used hierarchical regression analysis to test the hypotheses.

This research found that ALOS performance for teaching hospitals better than non-teaching hospitals, ALOS performance for hospitals in urban areas lower than in non-urban areas, while expected ALOS performance of larger hospitals higher than small hospitals.

Migdadi (2013) research investigated the operational determinants and consequences of hospitals' inpatients departments of the average length of stay through examining the correlation between those determinants and ALOS for 18 out of 30 Jordanian public hospitals of 2011 where 9 out of 12 departments of those hospitals was investigated. The operational determinants of average length of stay in this research were classified into: location, capacity determinants, service workforce availability and delivery determinants. Moreover, consequences of average length of stay were classified into mortality and cost.

The data used in this research was from the Ministry of Health annual reports. This research used non-parametric techniques to analyze data; Spearman correlation coefficient to identify the degree of impact between variables, and Kruskal Wallis H-Test to identify the significant differences between urban and suburban hospitals.

This research found that the location is significant for the average length of stay for limited number of departments, average length of stay in suburban regions is less than in urban regions for all departments. The capacity is not significant for all inpatients departments; the capacity of stay was a positive determinant for some departments. Admission and discharge operations capacity is a positive determinant for the average length of stay for all departments except orthopedic. The capacity of x-ray operations is a positive determinant for some departments. Moreover, the productivity of employees and beds is a negative determinant for the average length of stay for all departments except orthopedics and ICU. However, the total number of stay days as gauge for productivity showed that productivity was a negative determinant for several departments. The average length of stay affected mortality rate and cost per patients for limited number of inpatients departments

2.4 Summary of Previous Studies

Al-Shammari (1999); **Helmig and Lapsley (2001); Gannon (2004); Rebba and Rizzi (2006); Maruotti (2007); Ajlouni (2013); Yawe (2010)** researches focused mainly on reporting the relative efficiency for the hospital as a whole, in other words, it focused mainly on reporting efficiency with limited concern about the departments in general and operational determinants in particular. However, all of them did not investigate the differences of efficiency among hospitals and the differences of efficiency among departments.

Raoof (2007) research identified the main lines for planning considerations of governmental hospitals within healthcare sector in Iraq as a conceptual framework.

Toodi, Featherston and Young (1998) research investigated the impact of single operational determinant of efficiency. In addition, it did not include explanatory charts and figures.

McDermott and Stock (2007) research focused mainly on reporting the impact of operational determinants on average length of stay as a performance indicator with limited concern about the departments**.**

Migdadi (2013) research investigated limited number of operational determinants.

2.5 Conclusion

The purpose of this chapter is to identify the previous studies that support the topic, and to fill the gaps in them. It included three sections: literature of efficiency, literature of operational determinants, and summary of previous studied.

Chapter Three

Efficiency Measures and Analysis Techniques

3.1 Introduction

Efficiency, the core concept in this research, as well as definition, technical, allocative, and productive measures, and the techniques of analysis that include: parametric and non parametric are explained in this chapter. It includes three sections; definition of efficiency, definition of measures, and analytical Techniques of efficiency.

3.2 Definition of Efficiency

Efficiency in healthcare sector, according to Gannon (2004), is the use of hospitals' resources successfully to transform inputs into outputs, and it is the degree at which optimal resources used match the observed resources to convert inputs to outputs of a given quality. Furthermore, efficiency according to Achabal et al., (1984), is minimizing the costs and dealing cautiously with resources to allocate them across alternative uses. The emphasis on hospitals efficiency measures is being increased due to the need to exploit scarce resources (Jacobs, 2000).

Efficiency is one of the core concepts of economics (Bdour et al., 2008). It is one of central terms that is used to assess and measure performance of organizations (Mouza, 2006). It is the ratio between the weighted sum of outputs to weighted sum of inputs (Hollingsworth et al., 1998). Further, efficiency is one of performance indicators and measures, productivity leads to efficiency; in the most productive hospitals, the health care system can achieve cost efficiency rather than in the least productive hospitals where the same number of patients are handled (cited in Burns et al., 1994). However, Achabal et al., (1984) reported that productivity is considered as integral part of efficiency.

However, engineering concept that measures the performance of the system at available resources is called technical efficiency, which is one of efficiency measures that have to be discussed in the next section. Moreover, it is related maximizing output (Coelli et al., 1995).

There are two ways to define efficient utilization of resources: minimum cost for producing a given level of outputs or maximum level of outputs from a specific expenditure (Achabal et al., 1984). There are two types of inefficiency that can result from handling when information of prices and costs are known: technical inefficiency that occurs when behavior of some inputs or outputs are inefficient (Cooper et al., 2000), and allocative inefficiency that occurs due to employed resources in the wrong mix (Fried et al., 2008). The units that rated as relatively inefficient can increase revenues of returns to scale from marketing activities (Keh et al., 2004). Returns to scale as an indicator of performance can be defined as: "the proportional change between inputs and outputs." While variable returns to scale can be defined as: "greater proportional change in outputs relative to inputs" (Bdour et al., 2008).

3.3 Definition of Measures

Estimating efficiency in all fields is very difficult particularly in healthcare field. Maruotti (2007) and Ajlouni (2013) have pointed out that the efficiency estimation in healthcare sector is more difficult than other studies, due to products of hospitals differentiate by non-parametric measurable.

Economists have developed three main efficiency measures: technical efficiency, allocative and productive efficiencies (Worthington, 2004; Palmer et al., 1999). *Technical efficiency* is the physical relation between healthcare outcome and resources. The maximum possible improvement of outcome leads to a technically efficient position, which is obtained from a group of resource inputs. Technically inefficient occurs when less one type of input can produce the same or greater outcome (Palmer et al., 1999). Health outcomes can be classified into intermediate outputs (e.g. number of patients treated, patient-days) or a final health outcome (e.g. lower mortality rates).

Gannon (2004) reported that technical efficiency is concerned with transforming physical inputs such as raw materials into outputs such as goods. Farell (1957) have pointed out that technical efficiency is the ability of a firm to use a given set of inputs for producing maximum level of outputs, where this definition of technical efficiency led to the development of methods for measuring technical efficiencies.

This type can be measured by non-parametric and parametric evaluation methods which allow concurrence comparison of the inputs and outputs of a production process of hospital and produce brief indicators of efficiency (Rebba and Riz, 2006). Non-parametric linear programming approach called Data Envelopment Analysis firstly was introduced

by Charnes et al., (1978) and further developed by Banker et al., (1984), it will be examined in the last section.

Allocative efficiency is interested in choosing between the different combinations of technically efficient of inputs used to produce the maximum level of outputs. In other words, it reflects the ability of an organization to use inputs in optimum proportions, due to the high inputs prices and availability of production technology (Worthington, 2004). The concept of allocative efficiency takes into account; the productive efficiency, which uses healthcare resources to produce required health outcomes, and efficiency that distributed these outcomes among the community (Palmer et al., 1999) which means it is realized when resources are allocated in order to maximize the welfare of the community.

Productive efficiency also is known as total economic efficiency. Palmer et al., (1999); Gannon (2004); and Worthington (2004) reported that the concept of productive efficiency is defined as the combination of allocative and technical efficiency. Palmer et al., (1999) pointed out that the concept of productive efficiency means either maximizing the health outcomes for a given cost, or minimizing the cost for a given outcomes. Health care allows assessment of the relative value of money of interventions comparable with outcomes. It cannot address the effect of reallocating resources on a broader level. If organizations of healthcare use its resources technically and allocatively efficient, they can thus be said that total economic efficiency has been achieved. Technical efficiency handles the issue of maximizing advantage by using given resources; allocative efficiency maximizes the health of society by achieving the right mixture of healthcare programmes; and productive efficiency achieves the maximum health benefit by choosing different combinations of resources for a given cost (Worthington, 2004).

3.4 Analytical Techniques of Efficiency

All efficiency measures assume the production frontier of the fully efficient organization is known where the production frontier can be estimated by using a sample of data. Accordingly, there are two approaches can be used: a nonparametric approach defined as the mathematical programming approach to construct frontiers, and a parametric approach that can be known as the econometric approach. These approaches used different techniques for envelopment the observed data. Thus, make different accommodations for flexibility and for random noise in the production technology structure (Worthington, 2004).

Two types of techniques are used in the analyses: parametric and non-parametric. Parametric technique includes: Ordinary Least Squares (OLS) regression and Stochastic Frontier Analysis (SFA). Non-parametric technique which is called Data Envelopment Analysis (DEA) (Webster et al., 1998). Parametric analyses needs a pervious definition of a hospital services' production function, while the non-parametric analyses specified the relative efficiency scores of similar DMUs by using linear programming techniques without description in details for their production processes (Chirikos et al., 2000). Nevertheless, both methods permit the consideration of heterogeneity of the output produced by different decision making units, and they are very suitable to compare the efficiency of different hospitals by developing indicators (Rebba et al., 2006).

Farrell (1957) developed methods based on the concepts of efficiency measurement then showed that there are two different frontier methodologies to measure the efficiency of health care organizations: SFA and DEA.

DEA is developed by Charnes et al., (1978) and Banker et al., (1984). This method is used for the efficiency measurement when multiple inputs and outputs are observed and when it is not possible to convert them into one aggregate input or output factor. Since 1978, DEA analysis technique is used in about thousands of articles, which have been published in various fields (Martín, 2003).

Stochastic Frontier Analysis (SFA) and Data Envelopment Analysis (DEA) are techniques that examine hospital efficiency (Jacobs, 2000). DEA method is especially enough to estimate the efficiency of non-profit organizations that operate outside the market, because the measures of efficiency for them such as income do not work satisfactorily. Two main reasons make these organizations work unsatisfactorily. Firstly, they do not focus on obtaining profits. Secondary, the main source of finances does not come from the sale of goods and services (Martín, 2003).

Through comparing the organization's actual behavior against the economic efficiency benchmark, the degree of efficiency can be determined by some real world agency (Worthington, 2004). DEA is a very powerful benchmarking technique. It is proved to define ways where as some other techniques to improve services are not clear (Zhu and Sherman, 2006).

DEA offers an indicator of the units to evaluate comparative efficiency. The units analyzed are known as decision-making units. In DEA, the relative efficiency can be defined as the ratio between the weighted sum of outputs to weighted sum of inputs. Outputs and inputs can be expressed by any unit of measurement if the homogeneity is maintained (Martín, 2003).

DEA can be defined as a linear programming technique that measures efficiency depending on differences between observed and best practice units (Gannon, 2004; Al-Shammari, 1999). SFA can be used to identify the inefficiency correlations, and the estimates of inefficiency generated by SFA hold promise for use in schemes that reward efficient providers (Maruotti, 2007).

DEA can rate efficiency, locate the sources of inefficiency and estimate the amounts of efficiency. The magnitude of excess resources and the deficient outputs produced are inefficiencies (Bdour et al., 2008). The window analysis is one of applications on DEA which consists of a structured method to mix in a single application, it is used when data of DMUs varies over time, and this process is done by performing multiple applications of DEA, according to different combinations of years. Thus, it is possible to the conclusion that the window analysis is also an important means (Cooper et al., 2000).

3.5 Conclusion

The purpose of this chapter is to explain the most important points of efficiency. Definition of efficiency, measures of efficiency: technical, allocative, and productive efficiency, analytical techniques of efficiency: parametric and nonparametric techniques were explained in this chapter.

Chapter Four

Conceptual Framework

4.1 Introduction

The aim of this chapter is to explain theoretical background of operational determinants that includes definition and categories: structural and infrastructural, to infer the relationship between efficiency and operational determinates, to estimate a model, and to formulate alternative hypotheses. Operational determinants that used in this research are structural determinants. This chapter includes five sections: definition of operational determinants, categories of operational determinants, relationship between efficiency and determinant, estimation model, and hypotheses.

4.2 Definition of Operational Determinants

Operations management: can be defined as the systematic processes including design, direction and control, which convert inputs into outputs. Operation: a set of resources that performs all or part of one or more processes (Krajewski, 2010). Operations strategy: can be defined as a set of practices or decisions regarding to structural and infrastructural variables where these strategic decisions influence on abilities of the firm to obtain the expected performance (Garrido et al., 2007). In addition, managers of companies should be understood what types of manufacturing structure and infrastructure that fit their environment (Ketokivi, 2003). Accordingly, operational determinants are factors, which affect on operations management and operations strategy.

4.3 Categories of Operational Determinants

Operational determinants affect efficiency, they could be categorized into structural and infrastructural actions (Skinner, 1974; Garrido, 2007). Structural actions that are made by the operations managers or units including location, process design and capacity, while the infrastructural actions which are made by other departments or managers to support the operations such as workforce management, quality, and product and service design actions. Both structural and infrastructural can be affected the Average Length of Stay as performance indicator (Migdadi, 2013; Garrido et al., 2007).

It is worth mentioning that several studies considered Average Length of Stay as performance indicator (e.g. Booth et al., 2005; McDermott and Stock, 2007; and Migdadi 2013). However, in other studies, it is considered as a medical factor of efficiency (e.g. Raoof, 2007), in this research, it is considered as one of operational determinants that can affect efficiency.

Identifying factors associated with the performance of hospital helps to understand the relationship between efficiency and variables (Toodi et al, 1998). The surveyed determinants in this research were examined by several studies such as Toodi et al. (1998); Thomas et al. (1981); and Raoof (2007), the effect of them on performance is examined by other studies (e.g. Lacalle and Martin, (2010); and Younis, 2003).

Structural and infrastructural operational determinants can be revised from available literature as it is shown in the following table (4-1) which includes a list of determinants. The classification of categories of structural determinants is identified as the following: location determinants, Average Length of Stay determinants, capacity determinants, and

process design determinants. Moreover, each category includes operations action that each of it could be classified into subcategories depends on them according to the value of inpatient operation chain processes as shown by Migdadi (2013). The infrastructural determinants are classified into categories: workforce attributes, Quality Management System, Production Planning and Inventory Management Systems, and Manufacturing Organization.

Table (4-1) : The list of operational determinants

	Categories of Operational determinant	Operations Actions	Reference
Structural	Location	Different regions of Location	McDermott and Stock (2007)
		Society (In terms of the Urban and Suburban)	Toodi et al. (1998)
		International comparison of hospitals (country)	Booth et al. (2005)
	Average Length of Stay	Time reduction of ALOS	Borghans (2008)
		ALOS as efficiency factor	Raoof (2007)
	Process design	reducing waiting time for operations	Wagener et al. (2011)
		Early imagining by both radiology and x-ray	Batlle et al., (2010)
	Capacity	Beds' number	McDermott and Stock (2007) ; Raoof (2007)
		staff members' number	Imai et al. (2005);
		High volume	Sun et al. (2012)
		Proportion of involuntary admission	Imai et al. (2005)
Infrastructural	Workforce attributes	Salaries	McDermott and Stock (2007)
		Specialization of staff	Capkun et al. (2012)
		Flexibility of workforce (Number of patients) per employee)	McDermott and Stock (2007); Booth et al. (2005)

……….Continue Table (4-1)

	Categories of Operational determinant	Operations Actions	Reference
Infrastructural	Workforce attributes	Teamwork (cooperation between employees)	Tunälv (1992)
	Quality Management system	quality control	Tunälv (1992), Garrido et al., 2007
		Total quality management	Ferdows et al. (1986); Tunälv (1992), Ward et al. (1988), Narasimhan et al. (2005), Garrido et al., (2007)
		Zero defect programs	Ferdows et al. (1986); Tunälv (1992), Ward et al. (1988), Narasimhan et al. (2005)
		Preventive maintenance	Ferdows et al. (1986); Tunälv (1992), Ward et al. (1988), Narasimhan et al. (2005)
		Continuous quality improvement	Ferdows et al. (1986); Tunälv (1992), Ward et al. (1988), Narasimhan et al. (2005)
	Production planning and Inventory management systems	production and Inventory control system	Ward et al. (1988), Ferdows et al. (1986), Tunälv (1992)
		Reduction time to prepare machinery	Tunälv (1992), Ward et al. (1988)
		Manufacturing lead time reduction	Tunälv (1992), Ward et al. (1988)
	Manufacturing Organization	Manufacturing reorganization	Ward et al. (1988), Ferdows et al. (1986)
		Multi-functional Project teams	Tunälv (1992), Ferdows et al. (1986)
		Decentralizing	Tunälv (1992), Ward et al. (1988)
		Reducing size manufacturing workforce	Tunälv (1992), Ward et al. (1988).

Developed by the researcher

Structural and infrastructural operational determinants affect efficiency according to previous studies (e.g. Garrido, 2007). Operational determinants that are used in this research are location of hospital, ALOS, occupancy rate, and capacity.

4.3.1 Location of Hospital

Location of hospital determines the hospital characteristics that correlated with efficiency (Toodi et al., 1998). According to Manning (1996) financial difficulties might be faced by rural hospitals. Rural hospitals are smaller than urban hospitals with average size less than 50 beds and rural hospitals depend on Medicaid and Medicare as a payment source (Younis, 2003). Rural hospitals are relatively less efficient than urban hospitals due to the competitive environment, demographic differences, proportion of non-patient income (Toodi et al., 1998). Characteristics of market competition in urban health care markets differ from rural ones (cited in Ferrier and Valdmanis, 1996).

4.3.2 Average Length of Stay

Average Length of Stay can be defined as duration of the patient's stay in hospital. Ajlouni (2013) defined it as number of days from admission to discharge, or it is average duration for inpatient hospital admissions. According to Health Policy Research Associates with Institute for Health Policy of 2007 Average Length of Stay and occupancy rate are considered as efficiency indicators. Reducing the duration of the patient's stay in hospital and take out patients from hospital as soon as there was no need to stay to give the opportunity for other patients is an achievement regarded as a medically good indicator of health services efficiency in general and private hospitals. This means several things,

including the patient recovery soon because diagnosis and treatment are efficient which lead to save costs, efforts and time to other patients (Raoof, 2007).

Lower values of Average Length of Stay indicate on better performance (McDermott, 2007). However it is not considered as a measure of efficiency but it is to achieve a profit within a healthcare system due to commercial pressure, lower Length of Stay can be achieved by supporting infrastructure for example nursing homes (Jones, 2013). Bed utilization and lower Length of Stay are not automatically linked (Jones, 2011).

4.3.3 Bed Occupancy Rate

Bed occupancy rates reflect the hospital ability to provide safe efficiency for patient care (Keegan, 2008). Predisposing bed occupancy rate and overall bed occupancy rate defined by (Raoof, 2007); the last one is the number of bed days occupancy during the year (or month), which gives clear indication of the actual demand of health services and efficiency.

1- The overall bed occupancy rate during the month or year = Total days stay during the month or year / (Number of month's days, or the number of year's days × Total number of beds) × 100 %

For example bed occupancy rate in this situation equal 50% in any given year that means half of the hospital beds are busy during this year.

2- The predisposing bed occupancy rate = Total days stay during the month or year/ (Number of month's days, or the number of year's days × Number of beds for inpatient predisposing) × 100 %

(Raoof, 2007)

4.3.4 Capacity

Capacity can be expressed by number of beds (McDermott and Stock, 2007; Raoof, 2007), number of staff member and proportion of involuntary admission (Imai et al., 2005). The size and capacity of the hospital is usually expressed by the number of beds, type and nature of other medical services provided by the hospital. Traditionally, the need of the health services are expressed by the number of obtainable beds, but that is not enough on its own because it does not give any idea about the nature and preparation of staff and other available medical services. Moreover, increased the number of beds considered as positive indicator to progress health services if the number of beds is less than the optimal number, but it is considered squandering in the potential if the number of beds is equal the optimal number (Raoof, 2007).

4.4 Relationship between Efficiency and Operational Determinants

Operational determinants are the independent variables and dependant variable is the efficiency. (See Figure 4-1)

4.4.1 Location

Toodi et al. (1998) found that: there are various differences between rural and urban hospitals, and rural hospitals are relatively less efficient than urban hospitals. Market competition characteristics in rural health care markets are different from urban ones (cited in Ferrier and Valdmanis, 1996). Younis (2003) stated that Small and rural hospitals face significant factors which impede their performance in comparison to larger and urban hospitals, which means urban hospitals are more efficient than rural ones, however rural and urban hospitals are similar in the efficiency. Whereas, Lacalle

(2010) stated that rural hospitals have better performance than urban hospitals in terms of satisfaction of the patients.

4.4.2 Average Length of Stay

Toodi et al. (1998) stated that identifying factors associated with the performance of hospital helps to understand the relationship between efficiency and omitted variables. McDermott (2007) stated that lower average lengths of stay values are considered a positive indication on performance and vice versa. Accordingly, Booth et al. (2005) found that the average length of stay in the UK is less than in New Zealand. Black and Pearson (2002) found that discharge and admission operations complexity is associated with longer length of stay. Capkun et al. (2012) found that healthcare service specialization leads to shorter length of stay. However, McDermott (2007) found that more risky hospitals or that involved more cases, on average; they may have higher length of stay for their patients.

4.4.3 Occupancy Rate

Rizzo (1991) found that rural hospitals are lower occupancy rates compared with urban hospitals. Ferrier and Valdmanis (1996); Toodi (1998); and Younis (2003) stated that rural hospitals are relatively less efficient than urban hospitals. Accordingly, hospitals of lower occupancy rates are relatively less efficient than hospitals of higher occupancy rates. Further, Keegan (2008) stated that hospitals with average occupancy rates above 85% can expect to have bed shortages and crises of periodic bed, which means less efficiency. Moreover, Chiu et al. (2011) stated that in some hotels, occupancy rate will be decreased to improve operations and profitability efficiencies.

4.4.4 Capacity

Raoof (2007) found that some developed countries that achieved optimal beds number in their hospitals considered decreasing the number of beds hospitals relative to their population an efficient indicator .However, Sun et al. (2012) stated that high hospital volume (the average numbers of procedures per year) results in more favorable outcomes after nephrectomy during hospitalization which means high hospital volume results in more efficiency in this situation. Black and Pearson (2002) explained that reducing the number of physicians would reduce the time available to see more patients accordingly, lower capacity to discharge and receive more patients.

4.5 Conceptual Model

Based on the above, the following Figure (4-1) shows the research model, it can be seen that; the operational determinants are the independent variables. These determinants are classified into average length of stay, occupancy rate, hospitals location, and capacity of hospitals' departments. However, the dependant variable is the efficiency that will be evaluated for hospitals' inpatients departments.

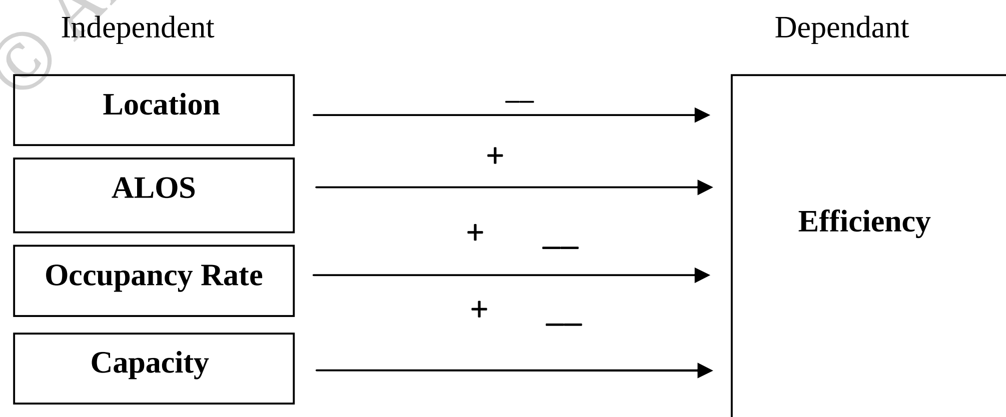


Figure (4-1): Research Model

Developed by the researcher

4.6 Hypotheses

According to the previous discussion for the relationship between independent and dependant variables, the hypotheses that derived from research model are:

1) There are significant differences between urban and suburban hospitals' efficiency at a significance level ($\alpha <= 0.05$).

2) There is a statistically significant relationship at the significance level ($\alpha <= 0.05$) between efficiency and average capacity.

3) There is a statistically significant relationship at the significance level ($\alpha <= 0.05$) between efficiency and the Average length of Stay.

4) There is a statistically significant relationship at the significance level ($\alpha <= 0.05$) between efficiency and occupancy rate.

4.7 Conclusion

This chapter offered a definition of operational determinants that investigated in this research: location, ALOS, occupancy rate, and capacity. Furthermore, conceptual model was estimated after investigating the relationship between efficiency and operational determinants by discussing previous studies. Efficiency has positive relationship with urban hospitals but it has negative relationship with rural ones, negative relationship between efficiency and ALOS, positive and negative relationship between capacity and efficiency , and positive relationship between efficiency and capacity. In addition, alternative hypotheses were formulated.

Chapter Five

Methodology

5.1 Introduction

The purpose of this chapter is to identify the research methodology used to achieve the research objectives. It also used as a road map of research, where it showed inputs, output, and operational determinants that were used in this research. This chapter discusses the different phases of this research, which are: identifying the list of inputs and outputs, identifying the list of operational determinants, the unit of analysis and sample, the techniques of analysis, data collection process, and data analysis.

5.2 Phase 1: Identifying the list of inputs and outputs

Inputs and outputs were identified by revising the available literature. The list of inputs and outputs are presented in Table (6-1). Input measures include number of beds, number of employees, amount of operational expenses, and total number of acute care admissions. Output measures include inpatient discharges, amount of expenses for educational facilities and teaching, inpatients days, the number of treatments provided by emergency services, and operations. In this research, two input measures were used to calculate efficiency: the number of employees and bed days, and one output measure was used to calculate efficiency is patient days.

Table (5-1): The input and output measures list

Input measures	Reference	Output measures	Reference
Number of beds	Helmig and Lapsley (2001), Gannon (2004), Rebba and Rizzi (2006) Yawe (2010), Ajlouni (2013)	Inpatient discharges	Helmig and Lapsley (2001) Gannon (2004)
Number of employees	Helmig and Lapsley (2001), Gannon (2004) Rebba and Rizzi (2006) Yawe (2010), Ajlouni (2013)	Amount of expenses for educational facilities and teaching	Helmig and Lapsley (2001)
Amount of operational expenses	Helmig and Lapsley (2001)	Inpatients days	Rebba and Rizzi (2006), Ajlouni (2013)
Total number of acute care admissions	Rebba and Rizzi (2006)	Number of treatments provided by emergency services	Rebba and Rizzi (2006)
		Operations	Ajlouni (2013), Yawe (2010)

Developed by the researcher

5.3 Phase 2: Identifying the list of operational determinants of efficiency

List of operational determinants for efficiency that was identified (see Table 4-1). In this research; urban and suburban areas as a location indicator were investigated and considered as a community factor. The number of admission as a capacity indicator was investigated since the available data are related to the number of admission. In addition, average length of stay and occupancy rate as operational determinants for efficiency were examined by this research.

5.4 Phase 3: Identifying unit of analysis and sample

All of previous studies have investigated efficiency at the hospital level (e.g. Ajlouni, 2013). Moreover, each department can be considered as a strategic unit. Each unit requires in-depth analysis for its efficiency and the impact of operational determinants. Investigating each department allows the practitioners and researchers to make a comparison between departments.

The previous studies have not investigated the impact of multi operational determinants on efficiency. Some studies have investigated the impact of one of operational determinants for efficiency such as location (e.g. Toodi et al., 1998), occupancy rate (e.g. Chiu et al., 2011), and capacity (e.g. Raoof, 2007). Investigating many operational determinants of efficiency can allow the practitioners and researchers to make a comparison between determinants.

In this research, the inpatient department of each public hospital in Jordan was the unit of analysis. This research investigated 9 out of 12 departments. Some departments

were excluded due to unavailability of data, and some departments were not available in all hospitals. It surveyed 15 out of 31 hospitals. These hospitals were chosen depending on the availability of data and they located in different regions in Jordan.

5.5 Phase 4: Collecting the Data

Secondary data was used by the most of previous studies that investigated efficiency and/or operational determinants, this data from different sources (e.g. Annual Statistical Reports). Source of efficiency and determinants data of this research were secondary. The data was retrieved from the Ministry of Health website. The Jordanian Ministry of Health has published these annual reports since 2005. This research is a snapshot research, which used the most recent data that has published in 2012.

5.6 Phase 5: The Data Analysis

5.6.1 Data analysis of efficiency

The majority of previous studies have used Data Envelopment Analysis technique to calculate efficiency (e.g. Ajlouni, 2013). This technique is used when multiple inputs and outputs are observed and when it is not possible to convert these into one aggregate input or output factor so it is the most suitable analysis technique to calculate efficiency. This technique was used in this research to calculate the efficiencies of hospitals' inpatients departments.

The objective is to minimize efficiency. The following linear programming formulas were used for this purpose.

E <= 1. . . . . **(1)** (Tayler, 2013)

$$\sum_{i=1}^{r} X_i * \lambda_i <= E * X_0 \ldots \textbf{(2)}$$ (Render, Stair, and Hanna 2012)

$$\sum_{i=1}^{r} Y_i * \lambda_i >= Y_0 \ldots\ldots \textbf{(3)}$$ (Render, Stair, and Hanna 2012)

$$\sum_{i=1}^{r} \lambda_i = 1 \ldots\ldots\ldots\ldots \textbf{(4)}$$ (Render, Stair, and Hanna 2012)

E: efficiency for the hospitals' inpatients departments, **λ:** weight for the hospitals' inpatients department, **X:** input for the hospitals' inpatients department, **Y:** output for the hospitals' inpatients department**,** X_0: input for the hospitals' inpatients department which we want to calculate efficiency for it Y_0: output for the hospitals' inpatients department which we want to calculate efficiency for it**.**

Classification of efficiency scale that used in this research divided as the following:

Extremely low	**(1-20)%**
Low	**> (20-40)%**
Moderate	**> (40-60)%**
High	**> (60-80)%**
Extremely high	**> (80-100)%**

This classification developed by the researcher

Mann-Whitney U test as a nonparametric method is used to compare the differences of efficiency among hospitals and among departments.

5.6.2 Data analysis of operational determinants

The most appropriate analysis technique to be used is regression. Regression examines the relationships between two or more independent variables and a dependent variable.

The data of this research is not normally distributed; further, the sample size is too small. Accordingly, non-parametric technique was used to analyze the data. In order to identify the impact of capacity, average length of stay and occupancy rate on efficiency Spearman Correlation Coefficient was adopted, and in order to identify the impact of location on efficiency and differences between the efficiency of urban and the suburban departments of hospitals, K-Independent (Kruskal Wallis) test was used.

The detailed procedure of data analysis is presented in appendix (A)

5.7 Conclusion

The aim of this chapter is to investigate the different phases that were used to write the research. It discussed inputs, output, operational determinants, and scale of efficiency. It included five phases: identifying the list of inputs and outputs, identifying the list of operational determinants of efficiency, identifying unit of analysis and sample, collecting data, and data analysis.

Chapter Six

Data Analysis and Findings

6.1 Introduction

The findings of the data analysis are shown in this chapter which can be divided into two main parts: data analysis of productive efficiency of hospitals' inpatients departments, and data analysis that shows the relationships between the efficiency of hospitals' inpatients departments and location of hospital, ALOS, occupancy rate and capacity of those departments by using different analytical techniques.

6.2 Data Analysis of Efficiency

Table (7-1) shows the efficiencies of hospitals' inpatients departments, it can be seen that; all departments of Al-Basheer and Princess Basma hospitals are extremely high efficient. Those hospitals as a whole are considered extremely high efficient.

All departments except ICU of AL-Yarmouk are extremely high efficient, the hospital as a whole can be considered extremely high efficient.

Al-Mafraq hospital includes limited number of departments: general surgery and ICU are extremely high efficient, orthopedic and internal medicine are highly efficient departments. Generally, it is can be considered extremely high efficient hospital.

The Princess Salma hospital's departments are extremely high efficient except internal medicine which is considered a highly efficient department, and general surgery which is considered an extremely low efficient department. Generally Princess Salma can be considered an extremely high efficient hospital.

Gynecology department of Al-Ramtha hospital is low efficient, internal medicine is a moderately efficient department, neonatal and ophthalmology are highly efficient

departments, and the rest of them are extremely high efficient. Generally Al-Ramtha hospital can be considered highly efficient.

One moderately efficient department of Mua'th Bin Jabal hospital is pediatric, gynecology and neonatal are highly efficient departments, and the rest of them are extremely high efficient. It is considered highly efficient hospital.

Pediatric, ICU, and neonatal departments of Al-Zarqa hospital are extremely high efficient. General surgery, ophthalmology, and internal medicine departments are highly efficient however, the rest of departments are moderately efficient. This hospital is considered highly efficient

The extremely high efficient departments of Prince Faisal hospital are ICU and neonatal, the low efficient department is general surgery and the rest of them are highly efficient departments. Prince Faisal hospital is considered highly efficient.

Low efficient department of Al-Tutanjee hospital is gynecology, moderately efficient department is pediatric, highly efficient one is orthopedic, and the rest of them are extremely high efficient departments. It is considered highly efficient hospital.

One low efficient department of Abu-Obadiah hospital is orthopedic. Gynecology, ophthalmology and neonatal are moderately departments and the rest of them are extremely high efficient. Accordingly, this hospital can be considered highly efficient hospital.

Low efficient department of Al-Hussein hospital is genecology, moderately efficient departments are orthopedic and pediatric, high extremely one is neonatal and the rest of them are highly efficient departments. It is considered moderately efficient hospital.

Extremely high efficient department of Jarash hospital is ear nose and throat, high efficient departments are general surgery and pediatric, low efficient ones are orthopedic and genecology, and the rest of them are moderately efficient. It is considered moderately efficient hospital.

One extremely low efficient department of Al-Nadeem hospital is general surgery, genecology and neonatal departments are moderately efficient, and the rest of them are highly efficient departments. Accordingly, it is considered a moderately efficient hospital.

Neonatal department of Al-Hussein Bin Abdullah II hospital is extremely high efficient, general surgery is extremely low efficient, and the rest of them are moderately efficient departments. Accordingly, it is considered moderately efficient hospital.

The hospitals' inpatients departments can be classified into five categories according to the following table (7-1): extremely low efficient, low efficient, moderately efficient, highly efficient, and extremely high efficient. In general, extremely high efficient departments are ear nose and throat, and ICU. Moderately efficient department is gynecology, and the rest of them are highly efficient departments.

Table (6-1): The efficiencies of hospital's inpatients departments.

Departments / Hospital	Ear Nose and Throat	ICU	Neonatal	Internal Medicine	Ophthalmology	Pediatric	Orthopedic	General Surgery	Gynecology	Average
Basheer	100%	99%	99%	100%	99%	100%	100%	100%	100%	100%
Princess Basma	100%	____	____	100%	100%	____	100%	100%	____	100%
AL_Yarmouk	100%	74%	100%	100%	100%	100%	100%	100%	100%	97%
Al-Mafraq	____	86%	____	68%	____	____	73%	100%	____	82%
Princess Salma	____	100%	100%	75%	____	100%	_____	13%	100%	81%
Al-Ramtha	100%	91%	68%	59%	74%	84%	90%	100%	36%	78%
Mua'th Bin Jabal		100%	64%	85%	____	55%	____	85%	70%	77%
Al-Zarqa	60%	100%	87%	65%	61%	100%	57%	74%	46%	72%
Prince Faisal	____	100%	94%	80%	____	69%	____	23%	68%	72%
Al-Tutanjee	____	100%	85%	87%	____	47%	68%	86%	33%	72%
Abu-Obaidah	100%		48%	100%	50%	100%	25%	100%	55%	72%
Al-Hussein		76%	95%	63%	____	45%	58%	79%	34%	64%
Jarash	100%	48%	54%	55%	48%	67%	34%	66%	28%	56%
AL-Nadeem	____	76%	51%	61%	____	69%	____	20%	54%	55%
Al-Hussein Bin Abdullah II	____	52%	93%	46%	____	56%	____	12%	47%	51%
Average	94%	85%	80%	76%	76%	76%	71%	71%	59%	

Table (6-2) shows the differences among hospitals' efficiency, it can be seen that; there are not any significant differences of efficiency among all departments except among some: Such as, ear nose and throat department with some departments on one hand, ICU department with gynecology on the other hand.

Table (6-3) shows the differences among departments' efficiency, it can be seen that; there are significant differences of efficiency among some hospitals however, there are not significant differences of efficiency among other hospitals.

Table (6-2): Mann-Whitney U test results for the differences among departments' efficiency.

Departments / Hospital	Efficiency	Ear Nose and Throat	ICU	Neonatal	Internal Medicine	Ophthalmology	Pediatric	Orthopedic	General Surgery	Gynecology
Ear Nose and Throat	Mann-Whitney U		26	**16***	**24***	11	24	**15***	29	**14***
	Asymp. Sig		0.091	0.016	0.035	0.056	0.062	0.035	0.07	0.009
ICU	Mann-Whitney U	26		68	73	34.5	67	45.5	83	**39.5***
	Asymp. Sig	0.091		0.393	0.251	0.372	0.369	0.217	0.491	0.019
Neonatal	Mann-Whitney U	**16***	68		90.5	44	84	58	97.5	51
	Asymp. Sig	0.016	0.393		0.746	0.905	0.979	0.685	1	0.085
Internal Medicine	Mann-Whitney U	**24***	73	90.5		49.5	96.5	67.5	106.5	56.5
	Asymp. Sig	0.035	0.251	0.746		0.831	0.963	0.674	0.8	0.057
Ophthalmology	Mann-Whitney U	11	34.5	44	49.5		44	32	50.5	28
	Asymp. Sig	0.056	0.372	0.905	0.831		0. 903	0.767	0.885	0.162
Pediatric	Mann-Whitney U	24	67	84	96.5	44		59.5	97	50.5
	Asymp. Sig	0.062	0.369	0.979	0.963	0. 903		0.727	0.981	0.077
Orthopedic	Mann-Whitney U	**15***	45.5	58	67.5	32	59.5		71	48.5
	Asymp. Sig	0.035	0.217	0.685	0.674	0.767	0.727		0.82	0.302
General Surgery	Mann-Whitney U	29	83	97.5	106.5	50.5	97	71		78
	Asymp. Sig	0.07	0.491	1	0.8	0.885	0.981	0.82		0.361
Gynecology	Mann-Whitney U	**14***	**39.5***	51	56.5	28	50.5	48.5	78	
	Asymp. Sig	0.009	0.019	0.085	0.057	0.162	0.077	0.302	0.361	

Table (6-3): Mann-Whitney U test results for the differences among hospitals' efficiency.

Hospital	Efficiency	Basheer	Basma	Yarmouk	Mafraq	Salma	Ramtha	Mua'th Bin Jabal	Zarqa	Prince Faisal	Tutanjee	Abu Obaidah	Hussein	Jarash	Nadeem	Hussein Bin Abdullah II
Basheer	**M-W U**		15	33	**6***	24	**12***	**6***	**12***	**6***	**6***	24	**0***	**6***	**0***	**0***
	Sig.		0.16	0.361	0.043	0.672	0.008	0.009	0.008	0.009	0.005	0.195	0.001	0.002	0.001	0.001
Princess Basma	**M-W U**	15		20	**2.5***	10	**5***	**2.5***	**5***	**2.5***	**2.5***	10	**000***	**2.5***	**000***	**000***
	Sig.	0.16		0.456	0.029	0.176	0.013	0.013	0.013	0.013	0.009	0.074	0.003	0.005	0.004	0.004
Yarmouk	**M-W U**	33	20		**6***	21	**13.5***	**7***	**11.5***	**7***	**8***	20	**3***	**5***	**1***	**1***
	Sig.	0.361	0.456		0.024	0.312	0.009	0.008	0.005	0.008	0.006	0.056	0.001	0.001	0.001	0.001
Mafraq	**M-W U**	**6***	**2.5***	**6***		8	17.5	8.5	12	10	11.5	14	7	**3.5***	3	3
	Sig.	0.043	0.029	0.024		0.363	0.938	0.453	0.352	0.668	0.634	0.725	0.186	0.025	0.055	0.055
Princess Salma	**M-W U**	24	10	**21***	8		18	11	16	11	13	20	10	12	7	**6***
	Sig.	0.672	0.176	0.312	0.363		0.273	0.244	0.181	0.245	0.240	0.567	0.111	0.072	0.073	0.050
Ramtha	**M-W U**	**12***	**5***	**13.5***	17.5	18		24	32.5	24.5	26	35	19	**16***	11	11
	Sig.	0.008	0.013	0.009	0.938	0.273		0.722	0.477	0.767	0.595	0.922	0.185	0.030	0.059	0.059
Mua'th Bin Jabal	**M-W U**	**6***	**2.5***	**7***	8.5	11	24		24	17.5	20.5	22.5	13	**10***	6	6
	Sig.	0.009	0.013	0.008	0.453	0.244	0.722		0.722	0.936	0.943	0.843	0.252	0.044	0.054	0.054
Al-Zarqa	**M-W U**	**12***	**5***	**11.5***	12	16	32.5	24		23	30.5	35	25	22	16.5	10.5
	Sig.	0.008	0.013	0.005	0.352	0.181	0.477	0.722		0.636	0.915	0.922	0.491	0.101	0.215	0.051
Prince Faisal	**M-W U**	**6***	**2.5***	**7***	10	11	24.5	17.5	23		21	22	15	13.5	8.5	8
	Sig.	0.009	0.013	0.008	0.668	0.245	0.767	0.936	0.636		1	0.792	0.391	0.111	0.128	0.109

……….Continue Table (7-3)

Hospital	Efficiency	Basheer	Basma	Yarmouk	Mafraq	Salma	Ramtha	Mua'th Bin Jabal	Zarqa	Prince Faisal	Tutanjee	Abu Obaidah	Hussein	Jarash	Nadeem	Hussein Bin Abdullah II
Tutanjee	**M-W U**	**6***	**2.5***	**8***	11.5	13	26	20.5	30.5	21		24	18	19.5	12	12.5
	Sig.	0.005	0.009	0.006	0.634	0.240	0.595	0.943	0.915	1		0.637	0.406	0.203	0.199	0.224
Abu-Obaidah	**M-W U**	24	10	20	14	20	35	22.5	35	22	24		22	25.5	18	13
	Sig.	0.195	0.074	0.056	0.725	0.567	0.922	0.843	0.922	0.792	0.637		0.484	0.305	0.433	0.151
Hussein	**M-W U**	**0***	**000***	**3***	7	10	19	13	25	15	18	22		23.5	15.5	14
	Sig.	0.001	0.003	0.001	0.186	0.111	0.185	0.252	0.491	0.391	0.406	0.484		0.396	0.431	0.317
Jarash	**M-W U**	**6***	**2.5***	**5***	**3.5***	12	**16***	**10***	22	13.5	19.5	25.5	23.5		23.5	22
	Sig.	0.002	0.005	0.001	0.025	0.072	0.030	0.044	0.101	0.111	0.203	0.305	0.396		0.679	0.555
Nadeem	**M-W U**	**0***	**000***	**1***	3	7	11	6	16.5	8.5	12	18	15.5	23.5		13
	Sig.	0.001	0.004	0.001	0.055	0.073	0.059	0.054	0.215	0.128	0.199	0.433	0.431	0.679		0.423
Hussein Bin Abdullah II	**M-W U**	**0***	**000***	**1***	3	**6***	11	6	10.5	8	12.5	13	14	22	13	
	Sig.	0.001	0.004	0.001	0.055	0.050	0.059	0.054	0.051	0.109	0.224	0.151	0.317	0.555	0.423	

Tables (6-1), (6-2), and (6-3) developed by the researcher.

6.3 Data Analysis of Operational Determinants

6.3.1 The Location Determinants

Hypothesis 1: **There are significant differences between urban and suburban hospitals' efficiency at a significance level (α <= 0.05).**

The following Table (7-4) shows the impact of hospital location (urban or suburban) on the efficiency of hospitals' inpatients departments. It can be seen that; there are not significant differences between urban and suburban hospitals since (p<= 0.05).

-Classification of hospitals as urban and suburban according to Migdadi (2013)

Table (6-4): Kruskal -Wallis test result for the differences in urban and suburban hospital's efficiency.

Departments	Mean Rank		Chi-square Sig.	Asymp. Sig.
	Urban hospital	Suburban hospital		
General surgery	8.5	7.67	0.133	0.715
Orthopedic	6	5	0.28	0.597
Gynecology	6.2	7.5	0.347	0.556
Ear Nose and throat	3.33	4.5	1.333	0.248
Ophthalmology	4.83	3.38	0.795	0.372
Pediatric	6.4	7.38	0.204	0.651
Neonatal	8.6	6	1.375	0.241
Internal medicine	6.89	9.67	1.414	0.234
ICU	9	5.75	2.267	0.132

Developed by the researcher

6.3.2 Capacity Determinant of Efficiency

Hypothesis 2: **There is a statistically significant relationship at the significance level (α <= 0.05) between efficiency and average capacity.**

Table (6-5) shows the correlation coefficients matrix between the efficiency of hospitals' inpatients departments and capacity, occupancy rate and ALOS as operational determinants. It can be seen that; there is no significant relationship between capacity and efficiency of all hospitals' inpatients departments because the Sig. 2-tailed level for all departments is more than 5%. Accordingly, these findings reject the alternative hypothesis.

6.3.3 Average Length of Stay Determinate of Efficiency

Hypothesis 3: **There is a statistically significant relationship at the significance level (α <= 0.05) between efficiency and the Average Length of Stay.**

There is no significant relationship between average length of stay and efficiency of all hospitals' inpatients departments because the Sig. 2-tailed level for all departments is more than 5%. Accordingly, these findings reject the alternative hypothesis.

6.3.3 Occupancy Rate Determinate of Efficiency

Hypothesis 4: **There is a statistically significant relationship at the significance level (α <= 0.05) between efficiency and occupancy rate.**

There is a significant relationship between occupancy rate and efficiency in the following departments: general surgery, orthopedic, ophthalmology and internal medicine because the Sig. 2-tailed level for those departments is less than 5%, and the relationships are positive; 0.714, 0.644, 0.865 and 0.816 consecutive. These findings

prove the alternative hypothesis. However, there is no significant relationship between occupancy rate and efficiency in the following departments: gynecology, ear nose and throat, pediatric, prematurity and ICU because the Sig. 2-tailed level for those departments is more than 5% accordingly, these findings reject the alternative hypothesis.

Table (6-5): Spearman's correlation coefficient matrix for the relationships between occupancy rate, ALOS, capacity and efficiency of hospitals' inpatients departments.

Departments	Efficiency	ALOS	Capacity	Occupancy Rate
General surgery	Correlation Coefficient	0.238	.002	**0.535***
	Sig. (2-tailed)	0.393	0.995	0.040
	N	15	15	15
Orthopedic	Correlation Coefficient	0.037	0.264	**0.644***
	Sig. (2-tailed)	0.919	0.461	0.044
	N	10	10	10
Gynecology	Correlation Coefficient	-0.214	-0.227	-0.006
	Sig. (2-tailed)	0.483	0.457	0.986
	N	13	13	13
Ear Nose and throat	Correlation Coefficient	0.624	-0.204	0.408
	Sig. (2-tailed)	0.135	0.661	0.363
	N	7	7	7
Ophthalmology	Correlation Coefficient	-0.126	0.396	**0.865***
	Sig. (2-tailed)	0.788	0.379	.012
	N	7	7	7
Pediatric	Correlation Coefficient	-0.227	0.045	0.192
	Sig. (2-tailed)	0.456	0.883	0.529
	N	13	13	13
Neonatal	Correlation Coefficient	-0.003	0.201	0.506
	Sig. (2-tailed)	0.993	0.510	0.078
	N	13	13	13
Internal medicine	Correlation Coefficient	0.234	0.159	**0.816***
	Sig. (2-tailed)	0.401	0.572	0.000
	N	15	15	15
ICU	Correlation Coefficient	-0.003	-0.170	0.418
	Sig. (2-tailed)	0.993	0.580	0.155
	N	13	13	13

P<=0.05
***P<=0.01**

6.4 Conclusion

The aim of this chapter is to analyze data by using different techniques. It included two main sections: data analysis of efficiency and data analysis of operational determinants. The first section explained the efficiency of hospitals’ inpatients departments, the differences of efficiency among departments, and the differences of efficiency among hospitals. The second section explained the relationship of efficiency of hospitals' inpatients departments with ALOS, location, capacity, and occupancy rate.

Chapter Seven

Discussion and Conclusion

7.1 Introduction

The purpose of this chapter is to discuss the results of this research and how they are consistent with previous studies, to explain the interpretations and the researcher's opinion, and to report the conclusions, and recommendations.

This chapter is separated into four sections: discussion of efficiency results, discussion operational determinants results, contribution and results, and applications and future research. Accordingly, this chapter discusses the differences of efficiency scores among hospitals' inpatients departments and among hospitals as a whole. Further, it discusses why location, ALOS, capacity in all departments and occupancy rate in some departments are not determinants for efficiency.

Contribution in section three denotes on weight of this research. The applications and future research which present section four are used as a guide for other researchers and operation managers.

7.2 Efficiency

Extremely high efficient hospitals are Al-Basheer, Princess Basma, AL-Yarmouk, Al-Mafraq, and Princess Salma These results are consistent with Ajlouni (2013) and Al-Shammari (1999) studies. Al-Basheer is general, transformational, and teaching hospital, and it includes all departments. So the number of patients served is significant. This hospital contains modern medical devices that lead to the citizens' confidence on its services, thus it is motivation to increase the number of its visitors.

Princess Basma hospital has limited number of departments, but it is a teaching hospital and it has medical competencies. AL-Yarmouk hospital serves many people from surrounding villages. It has many modern facilities, and it possesses modern medical devices. Although the efficiency of ICU department in this hospital is lower than other departments due to the change of bed days, employees number and number of patient days is not at the same direction.

Jarash, AL-Nadeem, and Al-Hussein Bin Abdullah II hospitals are moderately efficient hospitals, and they have less efficiency score than of all other hospitals. According to Mousa Al- shahwan (Director of Al-Nadeem hospital, 2012) who said: AL-Nadeem hospital suffers from obsolescence of medical devices and a lack of competences which forces patients to search for other hospitals. The number of patients in Jarash hospital exceeds the available resource. Al-Hussein Bin Abdullah II is located in Ain Al Basha and determines in the west of Baqa'a camp. Its inhabitants of this camp prefer to receive treatment in a refugee organization for free, and they visit this hospital just for intractable cases. This attitude reduces the number of served patients.

In general, the department that has the lowest efficiency score is gynecology because all resources are not exploited to serve the maximum number of patients It is known that this department is extremely high efficient only in Al-Basheer, Princess Salma, and Al-Yarmouk hospitals. Also neonatal department in Al-Hussein Bin Abdullah II hospital has the highest efficiency score all departments in this hospital because of all resources are exploited to serve the required number of patients.

Ear nose and throat department is extremely high efficient in hospitals except in Al-Zarqa hospital due to the change of bed days, employees number and number of patient days in Al-Zarqa hospital is not at the same direction. ICU department in Al-Yarmouk hospital is less efficient than all departments in this hospital because this hospital does not have PICU department. Therefore, all cases that need intensive care are received in ICU department which increases its workload compared to other departments. Neonatal department of Al-Hussein hospital is more efficient than other departments in this hospital because this department has been set up recently, and it contains modern medical devices.

There are not significant differences of efficiency among the majority of departments because the strategic directions are similar, these departments are under the government supervision. There are significant differences of efficiency between ICU and gynecology departments because gynecology department has high workload more than ICU department where most cases do not require intensive care. Limited number of hospitals includes ear nose and throat department, in addition, it deals with variety of pathological cases from simple to complex which leads to the existence of significant differences of efficiency between this department and some other departments.

There are significant differences of efficiency among some hospitals because not all of them are convergent in absorptive capacity and workload. Basheer, Princess Salama, and Yarmouk hospitals have significant differences of efficiency with others because they are major and general hospitals. Jarash hospital has significant differences of efficiency with Al-Ramtha, Al-Mafaq, and Mua'th Bin Jabal hospitals because it is the only general governmental hospital in Jerash that has high population density 467.8 P/km 2

(Department of Statistics, 2012) which leads to high workload more than Ramtha, Al-Mafaq, and Mua'th Bin Jabal hospitals.

7.3 Operational determinants

7.3.1 The location determinants

The location is not a determinant for efficiencies of hospital's inpatients departments. This result is not consistent with previous studies (e.g. Toodi et al., 1998; Younis, 2003; and Lacalle, 2010). The sample of this research included inpatients departments for fifteen governmental hospitals where the most of their visitors have limited income. Those people are ready to go to any hospital when it is allowed, also health insurance network in Jordan covers more than pay for treatment. Furthermore there are multiple types of medical insurance: governmental, military, and private that determine the hospitals' visitors more than the locations of hospitals. Therefore, the location is not a determinant for efficiency of all departments in Jordan. Moreover, those hospitals are almost located in vital areas.

7.3.2 Capacity determinant of efficiency

capacity is not a determinant of the efficiencies of hospitals' inpatients departments because the number of admission depends on the type of diseases and the severity of the cases, furthermore, it depends on the availability and development of medical devices more than on number of beds, number of employees, and patient days that affect efficiency. This result is not consistent with previous studies although there is a difference in the operations actions of capacity (e.g. Sun et al., 2012) which found that there is a significant relationship between the efficiency of hospitals and their capacity.

7.3.3 Average length of stay determinant of efficiency

Average length of stay is not a determinant for efficiency since ALOS vary depending on the type and degree of diseases, and the degree of advance in medical care and management. This result is not consistent with previous studies (e.g. McDermott, 2007).

7.3.4 Occupancy rate determinant of efficiency

Occupancy rate is a positive determinant for efficiency of limited number of departments due to their high workload. This result is consistent with previous studies Rizzo (1991) Ferrier and Valdmanis (1996) Toodi (1998) and Younis (2003). Occupancy rate is not a determinant for efficiency of a number of hospitals' inpatients departments due to their low workload.

7.4 Contribution and results

This research has significant contribution which is related to reporting the efficiencies of hospitals' inpatients departments and investigating the operational determinants for the hospitals' inpatients departments efficiencies. To the best my knowledge, there are no researchs that studied this issue; The majority of previous studies have mainly focused on reporting the relative efficiency for the hospital as a whole. The previous studies have not investigated the impact of several operational determinants on efficiency.

The hospitals' inpatients departments can be classified into five categories: extremely low efficient, low efficient, moderately efficient, highly efficient, and extremely high efficient. In general, extremely high efficient departments are ear nose and throat, and ICU. Moderately efficient department is gynecology, and the rest of them are highly efficient

departments. There are not significant differences of efficiency among the most of departments. There are significant differences of efficiency among some hospitals.

Location of hospital, capacity, and ALOS are not determinants of efficiency for all hospitals' inpatients departments. Occupancy rate is not a determinant of efficiency for some departments.

7.5 The applications and future research

Operation managers can use the results of this research to help them making more accurate decision to improve efficiency for hospitals' inpatients departments that need improvement. In addition, maintain extremely high and high efficient hospitals' inpatients departments. They can predict the degree of impact of the occupancy rate for hospitals' inpatients departments on efficiency. The results of this research could be helpful for future researches to apply the same ideas of this research on a larger scale of hospitals to include private hospitals, hospitals at an international level or in other countries and used time series as a time framework.

This research based on the data, which is available of fifteen out of thirty-one ministry of health's hospitals and nine out of twelve inpatients departments, so the future research could focus on other hospitals and/or other departments. Moreover, this research focused on some operational determinants where there are other operational determinants and non operational determinants that may be affected hospitals' inpatients departments which also require more investigation by the future researches.

7.6 Conclusion

The aim of this chapter is to present findings that have emerged from data analysis. The results of analysis, interpretations and the researcher's opinion and how results are consistent with previous studies, conclusions of research, and Recommendations were discussed. Reasons of differences of efficiency between some departments and hospitals also were discussed.

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Appendix (A)

The Procedure of Data Analysis

A) Data analysis procedure of efficiency

Excel software was used in this research to calculate efficiency thus the next steps was followed:

- Step 1: Excel Solver was installed.

- Step 2: The collected data was entered on a separate sheet for each inpatient departments as presented in Figure (A-1).

	A	B	C	D	E	F
1		Beds	Bed days	Employee per bed	Employees	Patient days
2			input 1		input 2	Output 1
3	BASHEER	39	14235	2.4	94	13110
4	Al-Zarqa	12	4380	2.7	32	4019
5	Al-Husein/Salt	9	3285	4.4	40	2319
6	(Al-Mafraq	6	2190	6	36	1727
7	(Jarash)	9	3285	3.3	30	1414
8	Prince Faisal	4	1460	3	12	1279
9	AL_Nadeem	6	2190	3.3	20	1499
10	Princess Salma	2	730	5.3	11	268
11	(Al-Tutanjee / Madab	6	2190	3.9	23	2040
12	(Al-Ramtha)	6	2190	3.4	20	1805
13	Prince AL-Hussein Bi	8	2920	3.4	27	1342
14	AL_Yarmouk	5	1825	4.7	24	1138
15	Mua'th Bin Jabal	3	1095	3.1	9	651

Figure (A-1): Data sheet of inpatient department.

- Step 3: The constraints formulas were developed for each department on the data sheet.

- Step 4: Next, solver as analysis tool was chosen from data list.

- Step 5: Target cell and changing cell was identified and constraints was added in solver parameters window as presented in the Figure (A-2).

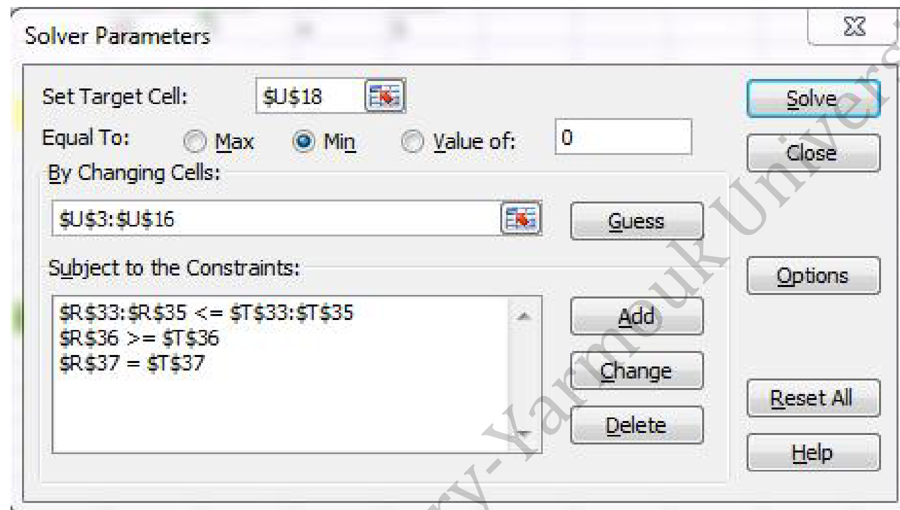


Figure (A-2): Solver parameters window.

- Step 6: linear, non negative and automatic scaling assumptions from options were determined as presented in Figure (A-3). Finally, click solve.

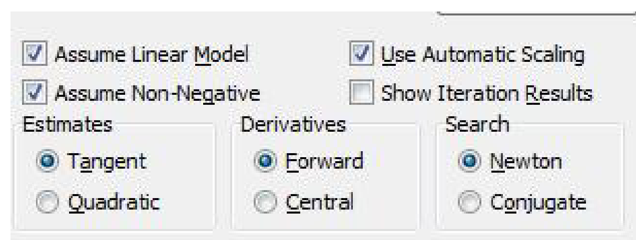


Figure (A-3): Solver options window.

(Render, Stair, and Hanna 2012)

SPSS software was used to compare efficiency among hospitals and among departments. The procedure used as following:

- Step 1: Variables were identified as presented in Figure (A-4)

- Step 2: The data was entered for variables as presented in Figure (A-5)

	Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	[illegible]
1	Eff	Numeric	8	2		None	None	8	Right	Sc
2	Department	Numeric	8	2		{1.00, G.S}...	None	8	Right	Nc
3										

Figure(A-4): variables data sheet.

Step 3: We analyzed data to compare efficiency.

Analyze ⟶ Non-parametric lists ⟶ 2- independent samples as presented in Figure (A-5).

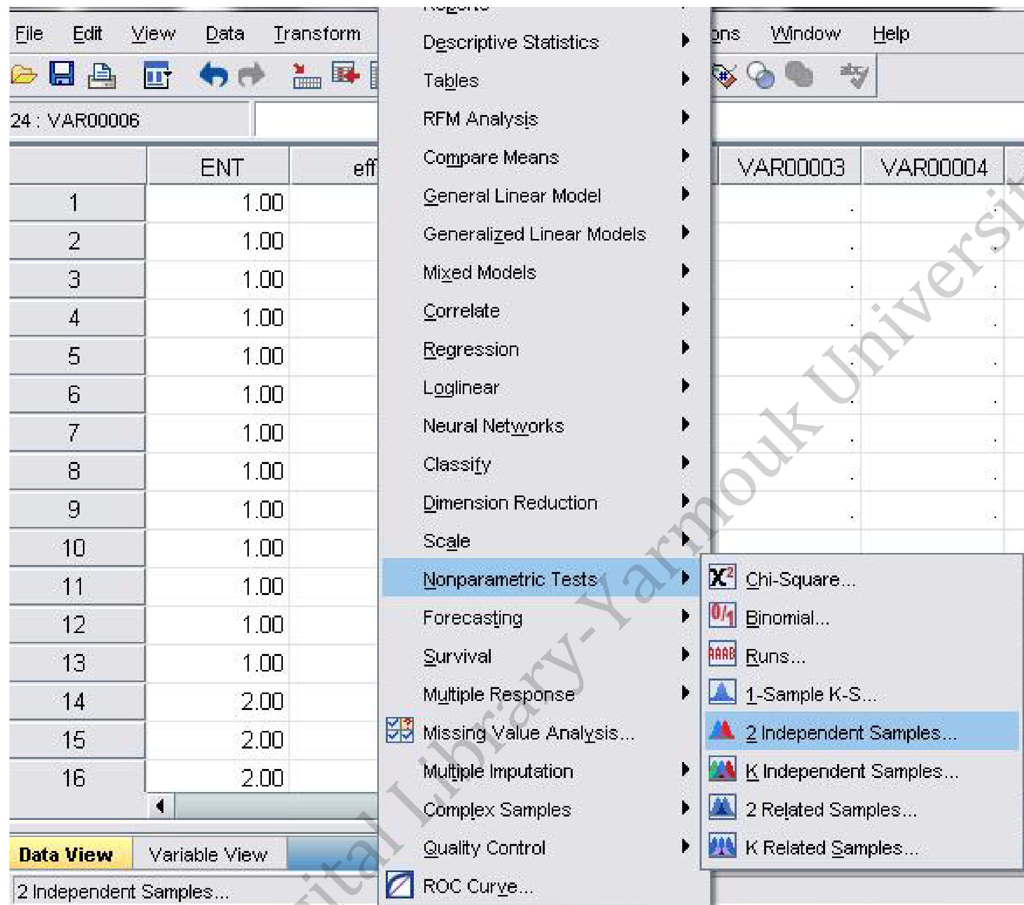


Figure (A-5): Data and 2- independent samples analysis procedure.

(Hinton et al. 2004)

B) Data analysis procedure of operational determinants

SPSS software was used to identify the impact of operational determinants of each inpatient department on efficiency. The procedure used as following:

- Step 1: All variables were identifid as presented in Figure (B-1).
- Step 2: The collected data was entered for all variables where each department separately as presented in Figure (B-2).

	Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure
1	Efi	Numeric	8	2		None	None	8	Right	Scale
2	Loca	Numeric	8	2		None	None	8	Right	Nominal
3	occ	Numeric	8	2		None	None	8	Right	Scale
4	ALOS	Numeric	8	2		None	None	8	Right	Scale
5	capacity	Numeric	8	2		None	None	8	Right	Scale

Figure (B-2): variables data sheet.

- Step 3: We analyzed the impact of location for efficiency.

Analyze → Non-parametric lists → K- independent samples as presented in figure (B-3).

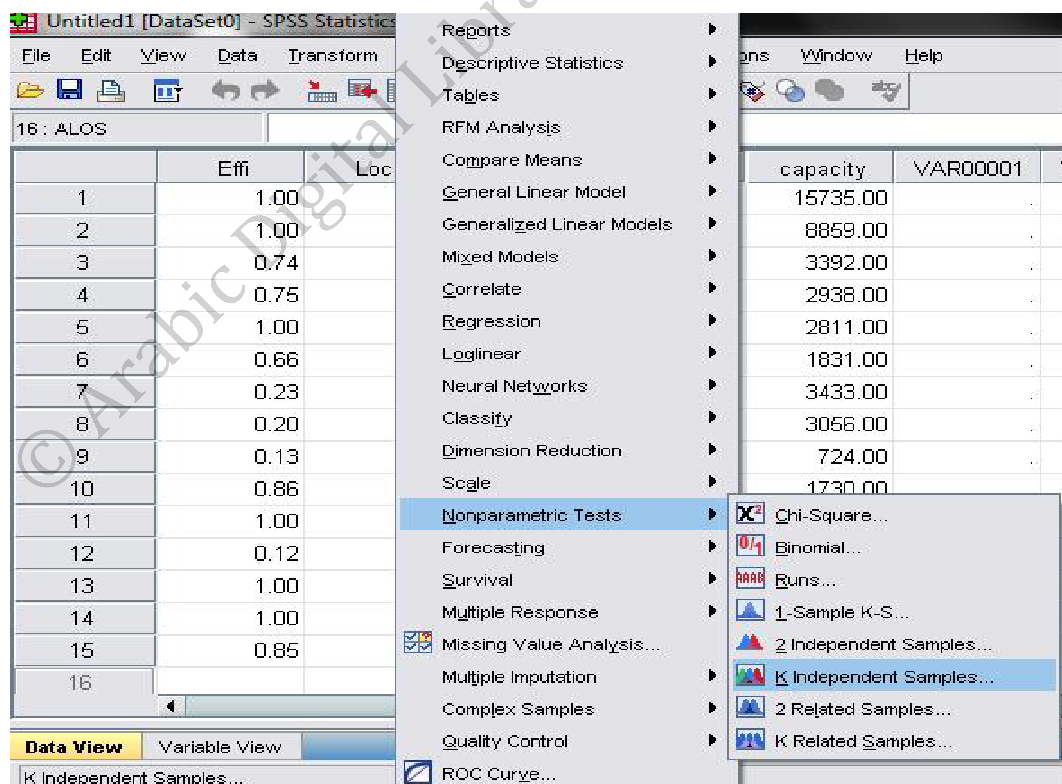


Figure (B-3): Data for each department and K- independent samples analysis procedure.

-Step 4: We analyzed the impact of occupancy rate, ALOS and capacity for efficiency as presented in figure (B-4).

Analyze ⟶ Correlate ⟶ Bivariate

Where Spearman Correlation Coefficient was adopted.

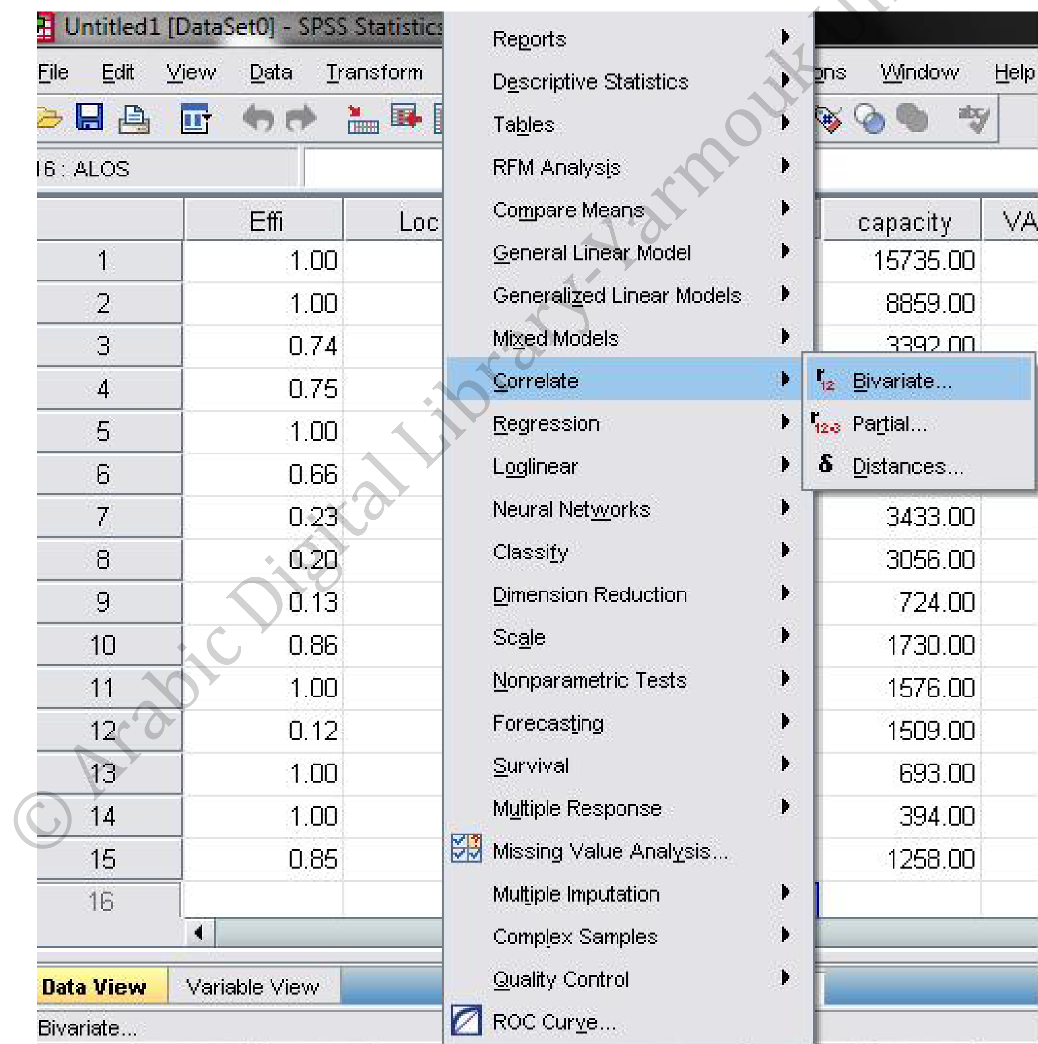


Figure (B-4): Bivariate correlation procedure.

(Hinton et al. 2004)

المحددات العملياتيه لكفاءة أقسام الإدخال للمستشفيات في الأردن

الملخص

يهدف هذا البحث لقياس كفاءة أقسام الإدخال للمستشفيات في الأردن لعام ٢٠١٢ وتقييم مدى تأثير كل من موقع المستشفى ومدة مكوث المريض و فترة إشغال السرير والسعة متمثلة بعدد الدخول على الكفاءة. تم استخدام البيانات الثانوية من التقارير السنوية لوزارة الصحة، تم دراسة خمسة عشر مستشفى من أصل واحد وثلاثون من مستشفيات وزارة الصحة، تسعة أقسام إدخال من أصل اثني عشر في كل منها.

تم قياس الكفاءة باستخدام أسلوب DEA، استُخدم اختبار مان وتني "ى" لمقارنة الاختلافات في الكفاءة بين المستشفيات والاختلافات في الكفاءه بين الاقسام، واستُخدم اختبار الاستقلال (kruskal-Wallis) لتحديد الارتباط بين الكفاءة والموقع. تم إستخدام أسلوب الارتباط المتعدد لتحديد العلاقات بين الكفاءة كمتغير تابع ومدة مكوث المريض و فترة إشغال السرير والسعة كمتغيرات مستقلة.

صُنفت أقسام الادخال الى خمس فئات: ذو كفاءة عاليه جدا، ذو كفاءة عاليه، متوسط الكفاءه، ذو كفاءه منخفضة، ذو كفاءه منخفضه جدا. تَبين في النتائج عدم وجود اختلافات في الكفاءة بين أقسام الادخال عدا قسم الاذنية مع بعض الاقسام وقسم العناية المشددة مع قسم النسائية، وجود اختلافات في الكفاءة بين بعض المستشفيات، وعدم وجود ارتباط بين كفاءة الأقسام وكل من الموقع ومدة مكوث المريض والسعة ولكن هناك ارتباط بين الكفاءة و فترة إشغال السرير لبعض الأقسام.

الكلمات المفتاحيه: الكفاءة، متوسط اقامة المريض، قسم ادخال، معدل الإشغال، السعة، محددات.